

JOSEPH J. GRAHAM
GEOLOGY DEPT.
STANFORD UNIVERSITY

CONTRIBUTIONS
FROM THE
CUSHMAN LABORATORY
FOR
FORAMINIFERAL RESEARCH

print this only

VOLUME 15, PART 1
MARCH, 1939

CONTENTS

	PAGE
No. 203. New Species of Foraminifera from the Oligocene and Miocene	1
No. 204. <i>Cribrolinoides</i> , a New Genus of the Foraminifera, its Develop- ment and Relationships.....	15
Recent Literature on the Foraminifera.....	19

SHARON, MASSACHUSETTS, U. S. A.
1939

CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

Brook Road, Sharon, Mass., U. S. A.

JOSEPH A. CUSHMAN, Sc.D., Director

ALICE E. CUSHMAN, Secretary, in charge of Publications

FRANCES L. PARKER, M.S., Research Assistant

PATRICIA G. EDWARDS, A. B., Research Assistant

ANN SHEPARD, Illustrator

These Contributions will be issued quarterly. They will contain short papers with plates, describing new forms and other interesting notes on the general research work on the foraminifera being done on the group by the workers in this laboratory. New literature as it comes to hand will be briefly reviewed.

Subscription \$2.50 per year post paid.

Volume 1, April 1925—January 1926 (Reprinted, 1935)	\$3.00
Volume 2, April 1926—January 1927 (Reprinted, 1935)	\$3.00
(Volume 3, part 1 now out of print.)	
Volume 3, parts 2-4, June—December, 1927 (Reprinted, 1936)	\$2.00
Volume 4, parts 1-4, March—December, 1928, complete	\$2.50
Volume 5, parts 1-4, March—December, 1929, complete	\$2.50
Index to Volumes 1—5 inclusive.	\$1.00
Volume 6, parts 1-4, March—December, 1930, complete	\$2.50
Volume 7, parts 1-4, March—December, 1931, complete	\$2.50
Volume 8, parts 1-4, March—December, 1932, complete	\$2.50
Volume 9, parts 1-4, March—December, 1933, complete	\$2.50
Volume 10, parts 1-4, March—December, 1934, complete	\$2.50
Index to Volumes 6-10 inclusive.	\$1.00
Volume 11, parts 1-4, March—December, 1935, complete	\$2.50
Volume 12, parts 1-4, March—December, 1936, complete	\$2.50
Volume 13, parts 1-4, March—December, 1937, complete	\$2.50
Volume 14, parts 1-4, March—December, 1938, complete	\$2.50
Volume 15 subscription, 1939	\$2.50

Special Publications:

No. 1. Foraminifera, Their Classification and Economic Use. 1928	\$5.00
No. 2. A Resumé of New Genera of the Foraminifera Erected Since Early 1928. 1930.50
No. 3. A Bibliography of American Foraminifera. 1932.	1.10
No. 4. Foraminifera, Their Classification and Economic Use, Ed. 2. 1933.	
No. 5. An Illustrated Key to the Genera of the Foraminifera. 1933. (No. 5 alone \$2.00; foreign \$2.50. Nos. 4 and 5 together, \$5.00; foreign \$6.00. No. 4 not sold separately.)	
No. 6. New Genera and Species of the Families Verneuilinidae and Valvulinidae and of the Subfamily Virgulininae. 1936	1.50

For continuation of this series, see back cover page.

Copies of Volume 15, part 1 were first mailed MARCH 22, 1939

PRESS OF M. A. JOHNSTON, BRIDGEWATER, MASSACHUSETTS, U. S. A.

CONTRIBUTIONS FROM THE CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

203. NEW SPECIES OF FORAMINIFERA FROM THE OLIGOCENE AND MIocene

By JOSEPH A. CUSHMAN and ALVA C. ELLISOR

The following species have been compared with the known species in their respective genera, and appear to be undescribed. Their relationship with those of other areas are interesting as throwing light on their derivation. They seem to have rather definite vertical ranges in the stratigraphic column of the Gulf Coastal region of the United States. It is possible that they may be found in other areas about the Gulf of Mexico or the Caribbean. We are indebted to Dr. Cecil G. Lalicker for help with the Textularias.

SPIROPLECTAMMINA BARROWI Cushman and Ellisor, n. sp. (Pl. 1, fig. 1)

Test much compressed, periphery subacute, slightly serrate, in front view broadest toward the apertural end, thence tapering gradually to the slightly rounded initial end, in end view rather regularly rhomboid, the thickness greatest in the median line, about one-half the breadth; chambers distinct, the earliest ones planispirally coiled about the proloculum, the earlier biserial ones very low and broad, gradually increasing in relative height in the adult, not inflated; sutures very distinct, somewhat curved throughout, not depressed but marked by definite lines of fine granules with much clear cement giving a very distinct appearance; wall very finely arenaceous with much cement, smoothly finished on the exterior; aperture rather narrow, almost semi-circular in end view, at the median line of the base of the last-formed chamber. Length 0.60-0.75 mm.; breadth 0.40-0.45 mm.; thickness 0.20-0.23 mm.

Holotype (Cushman Coll. No. 25210) from the Miocene, core sample from Shell Petroleum Corporation's No. 1 Realty Operators, Terrebonne Parish, Louisiana, at a depth of 9,248-50 feet.

This species differs from *Spiroplectammina gracilis* (von Münster) which occurs in the Miocene of the Atlantic Coastal Plain region of the United States, in the shorter, broader form, more acute periphery and more pointed initial end. It is named in honor of Mr. L. T. Barrow.

TEXTULARIA TATUMI Cushman and Ellisor, n. sp. (Pl. 1, fig. 2)

Test short and broad, length and breadth nearly equal, periphery subacute, especially in the early stages, convexly curved, greatest thickness along the median line, where in the adult the thickness is nearly as great as the breadth, apertural face truncate; chambers distinct, increasing very rapidly in size as added, much broader than high throughout, in the earliest portion linear and slightly depressed, in the adult very broad and raised above the general surface, strongly curved toward the periphery; wall finely arenaceous, smoothly finished, with much cement; aperture a broad, low opening at the base of the apertural face in the median line. Length 0.75-0.85 mm.; breadth 0.60-0.65 mm.; thickness 0.50-0.55 mm.

Holotype (Cushman Coll. No. 25213) from the Miocene, core sample from Amerada Oil Company's No. 1 St. Charles Land Company, St. Charles Parish, Louisiana, at a depth of 9,074-79 feet.

This species differs from *Textularia warreni* Cushman and Ellisor from the Eocene in the much greater thickness, smoother surface and more convex periphery. It is closely related to or identical with forms found in the fauna from Manta, Ecuador and elsewhere, referred to the lower Miocene.

TEXTULARIA TEASI Cushman and Ellisor, n. sp. (Pl. 1, fig. 3)

Test elongate, tapering, initial end subacute, thence gradually tapering with the greatest breadth formed by the last pair of chambers, periphery in the early portion acute or subacute, thence rapidly broadening and in the adult broadly rounded, median line slightly depressed; chambers fairly distinct in the early stages, not inflated, later becoming very distinct and much inflated, in the early stages very low and broad, later increasing rapidly in relative height, last chambers nearly as high as broad,

slightly overlapping; sutures of the early portion strongly oblique, not depressed, in the adult strongly depressed and nearly at right angles to the elongate axis; wall finely arenaceous and fairly smooth in the early stages, much coarser and somewhat roughened in the adult; aperture a semicircular opening in the median line of the base of the last-formed chamber. Length 0.60-0.75 mm.; breadth 0.35-0.40 mm.; thickness 0.25-0.28 mm.

Holotype (Cushman Coll. No. 25217) from the Oligocene, core sample from Continental Oil Company's No. 1 Hebert, Vermillion Parish, Louisiana, at a depth of 10,647 feet.

This species is closely related to *Textularia aciculata* d'Orbigny described from shore sands of Rimini, Italy. It differs from that species in the much more rounded periphery in a large part of the adult chambers, while in d'Orbigny's species usually but the last two or three pairs are very rotund, and the change in our species is more gradual.

BIGENERINA HUMBLEI Cushman and Ellisor, n. sp. (Pl. 1, fig. 4)

Test elongate, in the adult more than twice as long as broad, compressed, strongly so in the early portion, periphery somewhat serrate, subacute in the earliest stages, later rounded or somewhat truncate, the early portion tapering, adult with sides nearly parallel; chambers very distinct, for the most part biserial, later adult ones becoming uniserial, early ones low and broad, increasing rather regularly in relative height as added, the adult uniserial chambers with the height equal to or greater than the breadth, little if at all inflated except slightly so in the uniserial ones; sutures very distinct, in the adult uniserial portion sigmoid and slightly depressed, in the biserial portion nearly straight, raised, and somewhat granular; wall very finely arenaceous, with much cement, smoothly finished except at the sutures; aperture in the adult terminal, elliptical, with a slightly thickened lip. Length 0.85-1.00 mm.; breadth 0.40-0.45 mm.; thickness 0.20-0.23 mm.

Holotype (Cushman Coll. No. 25222) from the Miocene, core sample from Shell Petroleum Corporation's No. 1 Jeanererette L. & S., St. Martin Parish, Louisiana, at a depth of 7,650-54 feet.

This species differs from *Bigenerina pennatula* (Batsch) in the fewer uniserial chambers, broadly rounded periphery in the adult, and more rounded aperture. This is an easily identifiable

species, even from fragments, and should make a good index fossil for stratigraphic work.

BIGENERINA NODOSARIA d'Orbigny, var. **DIRECTA** Cushman and Ellisor, n. var.
(Pl. 1, fig. 5)

Variety differing from the typical in the smoother test, and more distinct chambers.

Holotype of variety (Cushman Coll. No. 25253) from the Miocene, core sample from Humble Oil and Refining Company's No. 1 Ellender, Terrebonne Parish, Louisiana, at a depth of 11,434 feet.

The typical form from the Mediterranean has a much rougher test. Our variety differs from *Bigenerina floridana* Cushman and Ponton in the larger proportion of uniserial chambers and reduction in the biserial stage. In most of its characters, it is nearer to *B. nodosaria*.

ROBULUS MAYERI Cushman and Ellisor, n. sp. (Pl. 1, fig. 6)

Test close coiled throughout, very thick in apertural view, the thickness about two-thirds the height, periphery with a distinct, thickened and somewhat rounded keel; chambers distinct, about ten in the adult whorl, of uniform shape, increasing very gradually in size as added; sutures distinct, raised, with a tendency to become beaded in the later portion, ending at the inner end in a series of raised knobs over the umbo; wall over the chambers smooth except in the earliest portion where there are a few raised, rounded areas over the chamber itself, one to a chamber, but not persisting on the later ones; aperture a rounded opening on the upper portion of the apertural face, with radiate slits above toward the peripheral angle. Height 0.60-0.75 mm.; breadth 0.55-0.60 mm.; thickness 0.50 mm.

Holotype (Cushman Coll. No. 25237) from the Miocene, core sample from Continental Oil Company's No. 2 Colonial Sugars, St. James Parish, Louisiana, at a depth of 7,753 feet.

This species differs from *Robulus americanus* Cushman found in the Florida Miocene, in the greater thickness, more prominent keel and the ornamented surface and sutures. It is named for Mr. Maurice J. Mayer.

ELPHIDIUM ROLSHAUSENI Cushman and Ellisor, n. sp. (Pl. 1, fig. 7)

Test much compressed, biumbonate, with a distinct, thickened keel, periphery rounded to subacute; chambers numerous, 13 to

15 in the adult coil, of uniform shape, increasing very gradually and evenly in size as added, not inflated, retral processes elongate, slender, extending nearly across the next-formed chamber, 6 to 8 in number, often spread out somewhat fan-shaped instead of entirely parallel, especially in the last-formed chambers; sutures indistinct, marked only by the rows of openings at the bases of the retral processes; wall distinctly perforate, smooth except near the earlier end of the visible coil where it may become finely papillate, the papillae usually in distinct rows; aperture consisting of several pores at the base of the apertural face of the last-formed chamber. Length 0.40-0.50 mm.; breadth 0.30-0.40 mm.; thickness 0.20 mm.

Holotype (Cushman Coll. No. 25248) from the Miocene, in core sample from Magnolia Petroleum Company's No. 1 A. Hebert, Big Lake, Cameron Parish, Louisiana, at a depth of 5,809-12 feet.

This species differs from *Elphidium advenum* (Cushman) found in the Florida Miocene in lacking the raised chambers, fewer and less regular retral processes, more prominent keel, and having strongly developed umbos.

It is named for Mr. F. W. Rolshausen.

BOLIVINA TENUISTRIATA Cushman and Ellisor, n. sp. (Pl. 1, fig. 8)

Test elongate, about 2½ times as long as broad, very gradually tapering from the blunt initial end, thickened and rounded in the middle, periphery subacute but not keeled; chambers numerous, earlier ones rather indistinct, later ones more distinct and slightly inflated; sutures mostly indistinct, strongly oblique, later ones slightly depressed; wall ornamented with numerous very fine longitudinal striations continuing to the last-formed pair of chambers; aperture large, elliptical. Length 0.65-0.75 mm.; breadth 0.25 mm.; thickness 0.15 mm.

Holotype (Cushman Coll. No. 25244) from the Oligocene, from core sample, Shell Petroleum Corporation's No. 1 Godchaux Sugars, St. John the Baptist Parish, Louisiana, at a depth of 9,240-50 feet.

This species differs from *Bolivina cookei* Cushman from the lower Oligocene of Alabama and Mississippi in the more elongate form, much finer ornamentation and more oblique sutures. From present evidence, this has a limited range in the Oligocene, and should make a useful index fossil.

BOLIVINA HARANGENSIS Cushman and Ellisor, n. sp. (Pl. 1, fig. 9)

Test comparatively short and broad, less than twice as long as broad, very much compressed, periphery acute but not keeled, tapering rather rapidly, greatest width formed by the last pair of chambers, apertural end rounded; chambers distinct, very slightly inflated, especially toward the apertural end, increasing gradually in relative height as added; sutures distinct, strongly oblique, later ones slightly depressed, the inner end curved backward as the basal angle of the chamber is extended backward near the median line; wall with numerous, distinct, longitudinal costae continuous over the sutures, and covering all but the last pair of chambers; aperture elongate, elliptical, in the median line. Length 0.50 mm.; breadth 0.30 mm.; thickness 0.10 mm.

Holotype (Cushman Coll. No. 25241) from the Miocene (?), core sample from Amerada Petroleum Company's No. 2 South Coast, La Fourche Parish, Louisiana, at a depth of 10,630-35 feet.

This species differs from *Bolivina marginata* Cushman, var. *multicostata* Cushman of the Florida Miocene in the broader, shorter form, less definite marginal keel, and larger number of more regular, longitudinal costae.

BOLIVINA COSTATA d'Orbigny, var. **DISSIMILIS** Cushman and Ellisor, n. var. (Pl. 1, fig. 10)

Variety differing from the typical in the more compressed test, especially in the early portion and the sutures which are straight and strongly oblique.

Holotype of variety (Cushman Coll. No. 25224) from the Miocene, core sample from Humble Oil and Refining Company's No. 1 Ellender, Terrebonne Parish, Louisiana, at a depth of 11,304 feet.

VIRGULINA EXILIS Cushman and Ellisor, n. sp. (Pl. 1, fig. 11)

Test elongate, slender, five or more times as long as broad, breadth and thickness about equal, sides parallel for most of their length, periphery broadly rounded, earliest portion triserial and somewhat twisted, the larger part biserial; chambers distinct, slightly inflated, of rather uniform shape and size in the adult, much higher than broad, the larger part of the test composed of the last four pairs of chambers, the last-formed one standing high above the others at the apertural end; sutures in the adult biserial portion distinct and somewhat depressed, strongly oblique; wall smooth; aperture elongate, slightly expanded at the

inner end, on the high apertural face. Length 0.60-0.65 mm.; breadth 0.13-0.15 mm.; thickness 0.10-0.13 mm.

Holotype (Cushman Coll. No. 25250) from the Oligocene, "Discorbina Zone" of core sample from Humble Oil and Refining Company's No. 1 Nordyke, Acadia Parish, Louisiana, at a depth of 8,096-8,101 feet.

This species differs from *Virgulina colei* Cushman from the Oligocene of Mexico which it somewhat resembles in the more slender form, and the larger number of biserial chambers which are much more regular in the adult than in the Mexican Oligocene species.

UVIGERINA PILULATA Cushman and Ellisor, n. sp. (Pl. 1, fig. 12)

Test short and stout, about 1 1/2 times as long as broad, fusiform, greatest breadth at or below the middle; chambers distinct, inflated, the last-formed whorl making up more than half the surface of the test, increasing rapidly in size as added; sutures distinct, depressed; wall ornamented with numerous longitudinal costae, not greatly raised, those of each chamber independent of adjacent ones, each costa very finely beaded at its outer edge which is rounded, the beading appearing almost as coarse perforations; aperture rounded, terminal, without a definite neck and lip. Length 0.38-0.43 mm.; diameter 0.25 mm.

Holotype (Cushman Coll. No. 25245) from the Oligocene, core sample from Shell Petroleum Corporation's No. 1 Godchaux Sugars, St. John the Baptist Parish, Louisiana, at a depth of 9,240-50 feet.

This species differs from *Uvigerina nuttalli* Cushman and Edwards of the Oligocene of Mexico in the much smaller size, more prominent costae and their peculiar, beaded appearance.

This should make a good marker for this part of the Oligocene. The finely beaded character of the costae is difficult to show in a drawing.

UVIGERINA LIRETTENSIS Cushman and Ellisor, n. sp. (Pl. 1, fig. 13)

Test short and stout, about twice as long as broad, tending slightly to become angled, fusiform, the initial end subacute, apertural end broadly truncate; chambers distinct, somewhat inflated, increasing rapidly in size as added, the three making the last whorl in the adult forming half the surface of the test, the last-formed one in the adult often rising distinctly above the others;

sutures very distinct, slightly depressed, strongly limbate; wall distinctly perforate, smooth except for the initial portion which has a few, rather indistinct, longitudinal costae which soon become obsolete; aperture in a slight depression of the obliquely truncate terminal face, with a very short, cylindrical neck, the aperture small for the size of the test. Length 0.75-0.85 mm.; diameter 0.38-0.40 mm.

Holotype (Cushman Coll. No. 25230) from core samples in the Miocene, Humble Oil and Refining Company's No. 1 Ellender, Terrebonne Parish, Louisiana, at a depth of 10,142-52 feet.

This species in some characters resembles *Uvigerina carapitana* Hedberg from the Oligocene of Venezuela, but differs in the

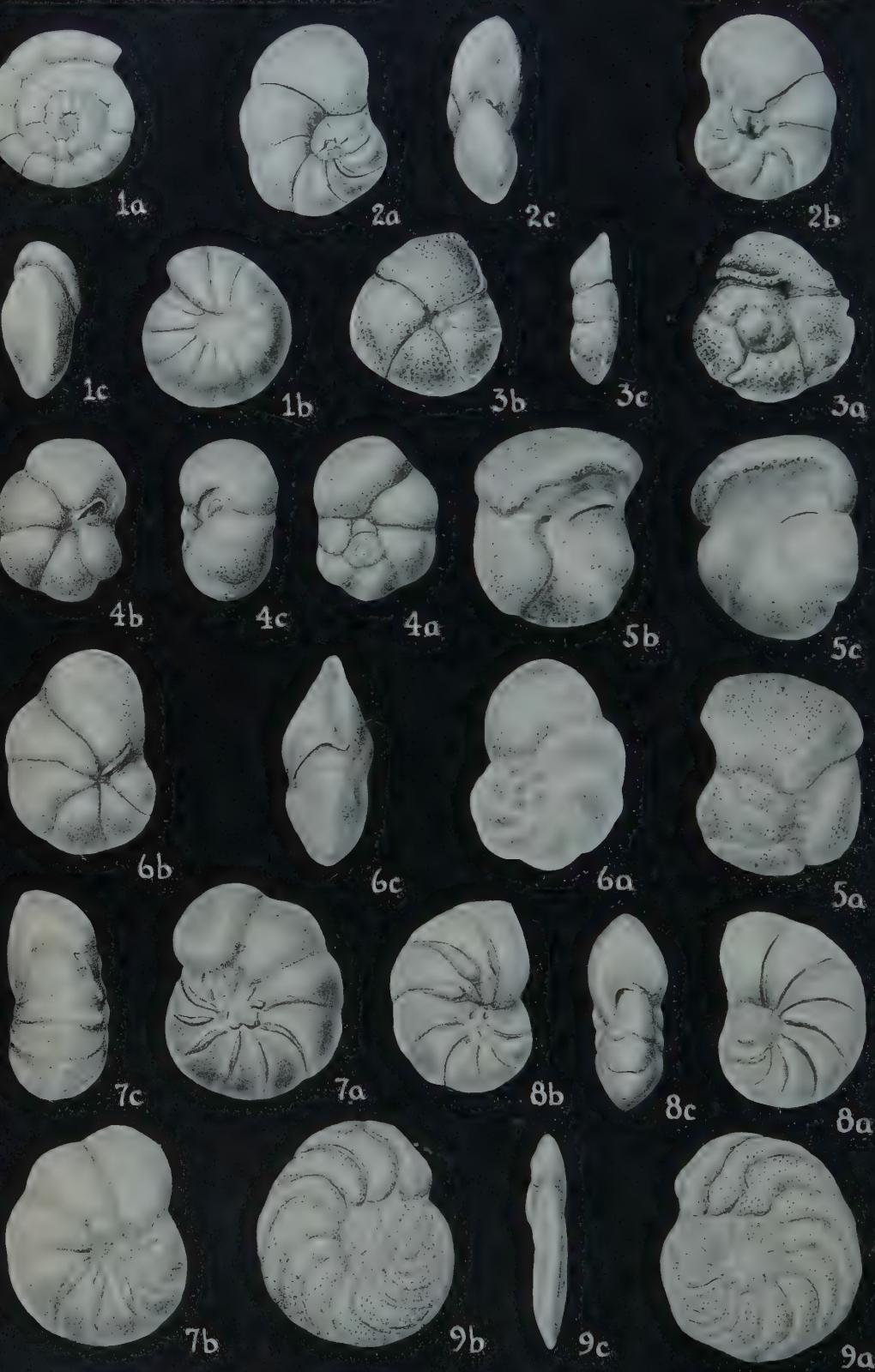
EXPLANATION OF PLATE 1

FIGS.

1. *Spiroplectammina barrowi* Cushman and Ellisor, n. sp. $\times 50$. Holotype. *a*, front view; *b*, apertural view.
2. *Textularia tatumi* Cushman and Ellisor, n. sp. $\times 45$. Holotype. *a*, front view; *b*, apertural view.
3. *T. teasi* Cushman and Ellisor, n. sp. $\times 45$. Holotype. *a*, front view; *b*, apertural view.
4. *Bigenerina humblei* Cushman and Ellisor, n. sp. $\times 40$. Holotype. *a*, front view; *b*, apertural view.
5. *B. nodosaria* d'Orbigny, var. *directa* Cushman and Ellisor, n. var. $\times 40$. Holotype. *a*, front view; *b*, apertural view.
6. *Robulus mayeri* Cushman and Ellisor, n. sp. $\times 55$. Holotype. *a*, side view; *b*, apertural view.
7. *Elphidium rolshauseni* Cushman and Ellisor, n. sp. $\times 65$. Holotype. *a*, side view; *b*, apertural view.
8. *Bolivina tenuistriata* Cushman and Ellisor, n. sp. $\times 55$. Holotype. *a*, front view; *b*, apertural view.
9. *B. harangensis* Cushman and Ellisor, n. sp. $\times 55$. Holotype. *a*, front view; *b*, apertural view.
10. *B. costata* d'Orbigny, var. *dissimilis* Cushman and Ellisor, n. var. $\times 55$. Holotype. *a*, front view; *b*, apertural view.
11. *Virgulina exilis* Cushman and Ellisor, n. sp. $\times 55$. Holotype. *a*, front view; *b*, apertural view.
12. *Uvigerina pilulata* Cushman and Ellisor, n. sp. $\times 65$. Holotype. *a*, front view; *b*, apertural view.
13. *U. lirettensis* Cushman and Ellisor, n. sp. $\times 40$. Holotype. *a*, front view; *b*, apertural view.
14. *U. altacostata* Cushman and Ellisor, n. sp. $\times 55$. Holotype. *a*, front view; *b*, apertural view.

From drawings by Patricia G. Edwards.





larger size, higher chambers in the adult, less conspicuous neck, and more truncate apertural end. Both species show faint longitudinal costae in the early chambers.

UVIGERINA ALTACOSTATA Cushman and Ellisor, n. sp. (Pl. 1, fig. 14)

Test fusiform, about twice as long as broad, apertural end more or less pointed; chambers fairly distinct, earlier ones often obscured by the ornamentation, strongly inflated; sutures depressed, distinct in the later portion; wall ornamented throughout with very high, longitudinal costae, those of each chamber independent of those of adjacent ones, the basal end of the costae often projecting, sometimes forming short claw-like projections; aperture terminal, rounded, with a distinct, tubular neck and occasionally a slight lip. Length 0.50-0.60 mm.; diameter 0.35 mm.

Holotype (Cushman Coll. No. 25216) from core material of probable Miocene age from Amerada Petroleum Company's No. 1 St. Charles Land Company, St. Charles Parish, Louisiana, at a depth of 9,104-14 feet.

This species differs from *U. vicksburgensis* Cushman and Ellisor in the more fusiform shape, more pointed apertural end with a more elongate neck, and the higher and fewer costae. It also resembles *U. stephensonii* Garrett, but is a stouter, coarser form than that species as a comparison with type material shows.

EXPLANATION OF PLATE 2

(In all figures: *a*, dorsal view; *b*, ventral view; *c*, peripheral view.)

FIGS.

1. *Gyroidina scalata* Garrett. $\times 65$.
2. *Discorbis subauraeana* Cushman, var. *dissona* Cushman and Ellisor, n. var. $\times 65$. Holotype.
3. *Siphonina davisi* Cushman and Ellisor, n. sp. $\times 60$. Holotype.
4. *Globorotalia mayeri* Cushman and Ellisor, n. sp. $\times 65$. Holotype.
5. *G. quadraria* Cushman and Ellisor, n. sp. $\times 65$. Holotype.
6. *G. foehsi* Cushman and Ellisor, n. sp. $\times 65$. Holotype.
7. *Cibicides carstensi* Cushman and Ellisor, n. sp., var. *opima* Cushman and Ellisor, n. var. $\times 40$. Holotype.
8. *C. carstensi* Cushman and Ellisor, n. sp. $\times 40$. Holotype.
9. *Planulina harangensis* Cushman and Ellisor, n. sp. $\times 40$. Holotype.

From drawings by Patricia G. Edwards.

GYROIDINA SCALATA Garrett (Pl. 2, fig. 1)

Gyroidina scalata GARRETT, Journ. Pal., vol. 12, 1938, p. 316, pl. 40, figs. 12, 13.

Figures are given of this very small but distinct species recently described from the Oligocene of Louisiana. Our specimens are almost identical in size with the types. They are from a core sample from Humble Oil and Refining Company's No. 1 Ellender, Terrebonne Parish, Louisiana, at a depth of 10,142 feet.

DISCORBIS SUBARAUCAINA Cushman, var. DISSONA Cushman and Ellisor, n. var.
(Pl. 2, fig. 2)

Variety differing from the typical in the slightly larger number of chambers in the whorl, less oblique and more strongly limbate sutures, and more elongate form.

Holotype of variety (Cushman Coll. No. 25251) from the Oligocene, core sample from Humble Oil and Refining Company's No. 1 Nordyke, Acadia Parish, Louisiana, at a depth of 8,096-8,101 feet.

This variety is very close if not identical with the form figured as *Discorbis subaraucana* from the Oligocene of Choctaw Bluff, Alabama (Cushman and McGlamery, U. S. Geol. Survey Prof. Paper 189-D, 1938, p. 109, pl. 26, fig. 13). The species seems to have a wide stratigraphic range.

SIPHONINA DAVISI Cushman and Ellisor, n. sp. (Pl. 2, fig. 3)

Test much compressed, somewhat unequally biconvex, dorsal side less convex than the ventral one, which is slightly umbilicate, dorsal side with a distinct, umbonal region somewhat raised above the general surface, periphery subacute but without a definite keel, typically entire and not at all serrate; chambers distinct, few, typically with five in the adult whorl, slightly inflated on both dorsal and ventral sides, increasing rapidly in size as added; sutures distinct, on the dorsal side nearly tangential, the last ones strongly limbate and slightly depressed, on the ventral side depressed, very slightly curved and nearly radial; wall very coarsely and distinctly perforate, on the ventral side the perforations sometimes depressed, giving a cancellated appearance to the wall; aperture, an elongate opening at the periphery of the last-formed chamber without a definite lip. Diameter 0.35-0.40 mm.; thickness 0.12 mm.

Holotype (Cushman Coll. No. 25219) from the Oligocene, core sample from Continental Oil Company's No. 1 Hebert, Vermillion Parish, Louisiana, at a depth of 10,647 feet.

This species in some respects resembles *Siphonina carltoni* Cushman and Ellisor from the Eocene, but differs from that species in the convex and umbonate dorsal surface, lack of a definite, peripheral keel, and a smooth periphery. It also differs from *S. jacksonensis* Cushman and Applin, var. *limbosa* Cushman from the Miocene of Florida in the lack of keel and in the different characters of the sutures. This is named for Mr. Morgan Davis.

GLOBOROTALIA MAYERI Cushman and Ellisor, n. sp. (Pl. 2, fig. 4)

Test unequally biconvex, the dorsal side slightly convex or nearly flattened, ventral side strongly convex and umbilicate, periphery very broadly rounded; chambers distinct, strongly inflated, increasing rapidly in size as added, of uniform shape, about six in the adult whorl; sutures distinct, slightly depressed, somewhat limbate on the dorsal side, on the ventral side more strongly depressed; wall smooth, coarsely and distinctly perforate; aperture large, extending on the ventral side from the umbilicus nearly to the middle of the peripheral margin, with a slight lip. Length 0.35-0.40 mm.; breadth 0.27-0.30 mm.; thickness 0.22 mm.

Holotype (Cushman Coll. No. 25236) from the Miocene, from core sample, Humble Oil and Refining Company's No. 1 Ellender, Terrebonne Parish, Louisiana, at a depth of 9,612 feet.

This species is named for Maurice J. Mayer. It differs from *Globorotalia scitula* (H. B. Brady) in the much thicker test, very much more rounded periphery, larger aperture, and more coarsely perforate wall.

GLOBOROTALIA QUADRARIA Cushman and Ellisor, n. sp. (Pl. 2, fig. 5)

Test very unequally biconvex, dorsal side slightly convex, ventral side very strongly so, periphery in the last-formed portion almost truncate, broadly rounded in the earlier portion, umbilicate on the ventral side; chambers distinct, strongly inflated, four in the adult whorl, the inner side of the final chamber flattened or even slightly concave, the face much higher than broad; sutures distinct, only slightly depressed, slightly limbate; wall very coarsely perforate except the apertural face which is finely perforate and much smoother than the remainder of the test which is cancellated; aperture, an elongate opening at the ventral margin of the last-formed chamber, extending to the umbilicus, with a slight lip. Diameter 0.40-0.50 mm.; height 0.35 mm.

Holotype (Cushman Coll. No. 25231) from the Miocene, core sample from Humble Oil and Refining Company's No. 1 Ellender, Terrebonne Parish, Louisiana, at a depth of 10,411-21 feet.

This species resembles *Globorotalia centralis* Cushman and Bermudez from the Eocene of Cuba, but differs from that species in the very coarsely perforate and cancellated surface, the very much flattened or even concave apertural face, and the more definitely quadrate final chamber. In some of its characters, it also resembles *G. dehiscens* Chapman, Parr and Collins from the Tertiary of Australia.

GLOBOROTALIA FOHSI Cushman and Ellisor, n. sp. (Pl. 2, fig. 6)

Test somewhat longer than broad, unequally biconvex, dorsal side somewhat less convex than the ventral side which is umbilicate, periphery of the earlier part subacute to slightly rounded, in the later portion more acute; chambers very distinct, six or seven in the adult whorl, increasing rapidly in size, and especially in height as added, slightly inflated, especially on the ventral side; sutures distinct, slightly depressed, more so on the ventral side, somewhat limbate dorsally, slightly curved and nearly radial on the ventral side, strongly curved on the dorsal side; wall distinctly perforate, smooth; aperture, an elongate opening on the

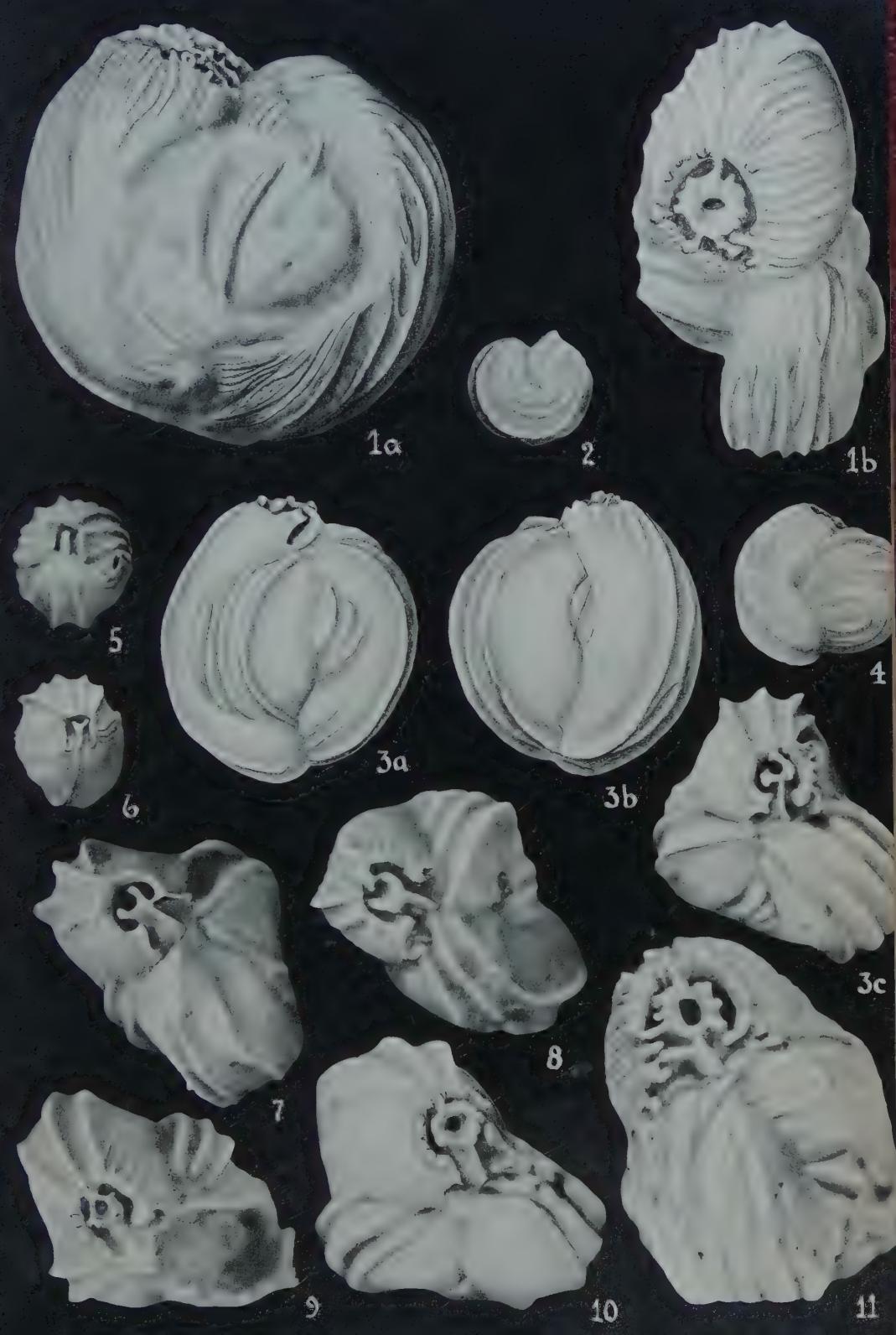
EXPLANATION OF PLATE 3

Cribrolinoides curta (Cushman)

Figures mostly from photographs. $\times 22\frac{1}{2}$.

FIGS.

1. Very large specimen tending in the adult stages toward *Massilina*. *a*, side view; *b*, apertural view.
2. Two-chambered "Cornuspira" stage. Side view.
3. Quinqueloculine stage; *a*, *b*, opposite sides; *c*, apertural view, showing fusion of the prong of the tooth with that of the opposite side.
4. Three-chambered stage with first quinqueloculine chamber added to the two-chambered "Cornuspira" stage.
- 5, 6. Two-chambered "Cornuspira" stage. Apertural views. 5, With simple linear tooth. 6, With bifid tooth.
- 7, 8. Stages with bifid tooth with long prongs, and in 8 with the ingrowing tooth at the edge of the periphery opposite the normal tooth.
- 9, 10. Showing the fusion and consequent development of the central, circular aperture, with two side openings.
11. Complicated aperture with additional radial teeth.





ventral side of the margin of the last-formed chamber, extending from the umbilicus nearly to the periphery, with a distinct lip. Length 0.45-0.55 mm.; breadth 0.30-0.35 mm.; thickness 0.20 mm.

Holotype (Cushman Coll. No. 25227) from the Miocene, core sample from Humble Oil and Refining Company's No. 1 Ellender, Terrebonne Parish, Louisiana, at a depth of 9,612 feet.

This should make a distinctive stratigraphic marker for the Miocene. It differs from *Globorotalia menardii* (d'Orbigny) in the shape of the chambers which are much lower in our species, more strongly curved sutures, and more elongate test. It is named for F. Julius Fohs.

CIBICIDES CARSTENSI Cushman and Ellisor, n. sp. (Pl. 2, fig. 8)

Test nearly equally biconvex, slightly longer than broad, slightly depressed in the middle part of both sides, periphery subacute to acute, but not keeled; chambers distinct, slightly inflated, increasing gradually in size as added, of nearly uniform shape; sutures very distinct, strongly limbate and slightly raised, thickened toward the middle, distinctly curved; wall smooth, finely but distinctly perforate; aperture extending from the periphery over onto the dorsal side, with a slight lip. Length 0.70-0.75 mm.; breadth 0.55-0.60 mm.; thickness 0.30 mm.

Holotype (Cushman Coll. No. 25226) from the Miocene, core sample from Humble Oil and Refining Company's No. 1 Ellender, Terrebonne Parish, Louisiana, at a depth of 10,142-52 feet.

This species strongly resembles *Cibicides yazooensis* Cushman from the Eocene of the Gulf Coastal Plain area of the United States. Our species differs in the somewhat larger number of

EXPLANATION OF PLATE 4

Cribrolinoides curta (Cushman)

Figures from photographs. $\times 22\frac{1}{2}$.

FIGS.

- 1, 2. Quinqueloculine specimens in transverse section. 1, Microspheric.
2, Megalospheric.
- 3, 4. Two-chambered "Cornuspira" stage. 3, Longitudinal section. 4, Transverse section.
- 5-11. Sections of early stages before the complete quinqueloculine stage is reached.
- 12, 13. Longitudinal sections of quinqueloculine specimens.

lower chambers, more prominent and raised sutures, and the very much flattened apertural face. It is named for Fred Carstens.

CIBICIDES CARSTENSI Cushman and Ellisor, n. sp., var. **OPIMA** Cushman and Ellisor, n. var.
(Pl. 2, fig. 7)

Variety differing from the typical in the much thicker and more rounded test, more inflated chambers, depressed sutures in the later portion, and more rounded periphery.

Holotype of variety (Cushman Coll. No. 25240) from the Miocene, core sample, from Amerada Petroleum Company's No. 2 South Coast, La Fourche Parish, Louisiana, at a depth of 10,880-900 feet.

PLANULINA HARANGENSIS Cushman and Ellisor, n. sp. (Pl. 2, fig. 9)

Test very strongly compressed, sides nearly flat, very slightly umbonate, somewhat evolute, periphery slightly rounded; chambers distinct, not inflated, numerous, 12 to 15 in the final whorl, low and broad, strongly curved; sutures distinct, strongly curved, more so toward the periphery, distinctly limbate, and raised in the earlier portion, slightly depressed in the last portion; wall very coarsely and distinctly perforate; aperture, a small opening at the periphery, and extending to the dorsal side, under a slight lip at the base of the last-formed chamber. Diameter 0.75-0.85 mm.; thickness 0.12-0.15 mm.

Holotype (Cushman Coll. No. 25214) from core material, probably of Miocene age, from Amerada Oil Company's No. 1 St. Charles Land Company, St. Charles Parish, Louisiana, at a depth of 9,044 feet.

This species differs from *Planulina mexicana* Cushman of the Oligocene of Mexico in the much less distinct chambers and sutures of the earliest portion, more limbate and raised sutures, and smaller size.

204. *CRIBROLINOIDES*, A NEW GENUS OF THE
FORAMINIFERA, ITS DEVELOPMENT
AND RELATIONSHIPS

By J. A. CUSHMAN and L. W. LEROY

A fine series of specimens from the Pliocene of Java collected by the junior author has made possible a study of the development of this peculiar species that has already been fairly well figured for the apertural characters. Sections have enabled us to study the development as shown by the internal arrangement of the chambers. From these studies and also from available Recent material from the Indo-Pacific, it seems that a new genus should be erected for the peculiar forms which will be discussed.

Genus *CRIBROLINOIDES* Cushman and LeRoy, n. gen.

Genoholotype, *Quinqueloculina curta* Cushman

Test with a globular proloculum followed by a second chamber a coil in length and planispiral, next by a series in typical quinqueloculine arrangement, and in the adult sometimes becoming more or less compressed toward a single plane; wall calcareous throughout; aperture in the earliest stages with a simple, linear tooth, later becoming bifid, then one of the tips elongating and joining the opposite side, the other tip curling about and attaching to the first, leaving a rounded opening, after which various teeth may develop from the central area and from the borders of the aperture to form a complex cibrate aperture.

As yet, but two species seem to be known of this peculiar genus, both confined to the Indo-Pacific area, both in the Pliocene and as living species. The synonymy of these two species will be given later.

The development of the aperture in these peculiar forms is a very interesting one. The photographs given on plate 3 show the stages in this development. In the two-chambered stage (figs. 5, 6), there are found specimens in which the aperture is quadrate in shape, and the single tooth developed is at first linear, as in

fig. 5, and later develops a bifid tip, as in fig. 6. In later chambers, the aperture becomes more rounded, and the tooth develops very prominent, curved projections (fig. 7). The next stage in development is for the point in the apertural rim opposite these projections to also develop a projection growing in toward the main tooth. At the same time, two distinct lobes are developed toward the base of the aperture at either side (fig. 8).

Following this stage, one of the two prongs of the main tooth grows outward and fuses with the tooth of the opposite side of the opening (fig. 3 c). In the next stage, the other prong of the main tooth grows forward and joins, leaving a circular opening in the center and two curved openings at the sides (fig. 9). In the further development, teeth are developed at the periphery of the main tooth, and also about the outer margin of the two curved openings (fig. 10). In later stages, these teeth fuse, and a very complex, cibrate aperture may result as shown in figs. 1 b and 11. In some specimens, the fusion of the teeth makes a series of radiate openings in addition to the central one, somewhat suggesting in a very irregular manner, the aperture developed in such specialized genera as *Idalina* and *Periloculina* from the Upper Cretaceous of France.

The developmental stages of the test itself are equally interesting. The proloculum is spherical or nearly so. In this particular collection, the megalospheric form was greatly predominant, only one of over eighty specimens sectioned proving to be microspheric. This is the opposite of the condition found by Hofker (Vid. Medd. Dansk nat. For., vol. 93, 1932 (1933), p. 98, pl. 3, figs. 13-25; text figs. 19, 20) in his material of this species in which microspheric forms predominated. The microspheric form is shown in Pl. 4, fig. 1. The chambers are regularly quinqueloculine throughout.

Following the proloculum, there is developed a second chamber, "Cornuspira-chamber," usually in the early stages of the Miliolidae in which a complete coil is made in one plane. This is the stage to which the generic name "*Uniloculina*" was given by d'Orbigny, but has since been found to be the early stage in very many species of different genera of the Miliolidae. This second chamber is distinctly ornamented with costae parallel to the periphery (Pl. 3, fig. 2). In section (Pl. 4, fig. 3), the second chamber is seen encircling the spherical proloculum, low in its early portion, and becoming higher toward the apertural end. A

section at right angles to this (Pl. 4, fig. 4), shows this difference in the height of the coil in the opposite parts of the coil. This stage in development may be seen in the sections of larger specimens on the same plate. Other sections of early stages are shown in figs. 5-8. The next stage in regular specimens is shown in fig. 9, where, after the "Cornuspira-stage," a chamber is developed at an angle. This is shown from the exterior (Pl. 3, fig. 4). This and succeeding chambers are but a half-coil in length, and are coarsely costate.

In the typical development, chambers are added at regular intervals, forming a test with five chambers making up the exterior. The early stages are shown in Pl. 4, figs. 10 and 11, and the complete test in section in fig. 2. Longitudinal sections of adult specimens are shown in Pl. 4, figs. 12 and 13.

In a few, very large specimens, there is a tendency for the last two or three chambers to be added nearly in a single plane, and thus simulating the type of test characteristic of *Massilina*. This development is rare however. Such specimens often have the apertural characters very complex as will be seen in Pl. 3, figs. 1 and 11.

The series shows very well the difficulties involved in attempting to describe a species with a complex development without abundant material showing all the stages. As already noted, d'Orbigny gave the name "*Uniloculina*" to the early, two-chambered stage of this group of the Miliolidae, and the early stages following might possibly be mistaken for *Triloculina*, and the very large specimens figured, if found alone, might even be referred to *Massilina* if the apertural characters were obscured.

The following species are referred to this genus:

CRIBROLINOIDES CURTA (Cushman)

Miliolina cuvieriana MILLETT (not *Quinqueloculina cuvieriana* d'ORBIGNY), Journ. Roy. Micr. Soc., 1898, p. 505, pl. 12, figs. 2 a, b.

Quinqueloculina disparilis d'ORBIGNY, var. *curta* CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 49, pl. 14, fig. 2; text fig. 30.

Quinqueloculina curta CUSHMAN, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 426, pl. 100, figs. 1, 2.—HADA, Trans. Sapporo Nat. Hist. Soc., vol. XI, pt. 1, 1929, p. 15; Sci. Rep't Tohoku Imp. Univ., ser. 4, Biol., vol. VI, 1931, p. 80, text figs. 33 a-c.—HOFKER, Vid. Medd. Dansk nat. For., vol. 93, 1932 (1933), p. 98, pl. 3, figs. 13-25; text figs. 19, 20.—(?) ASANO, Saito Ho-on Kai Museum Research Bull. No. 13, 1937, p. 113, pl. 15, figs. 1 a-c.

The various figures quoted above, with the exception of those of Asano, which do not seem to be typical, together with those given on our plates, give a very adequate idea of this species and its developmental details. Millett's material was from near Segaar, New Guinea. Cushman had it from numerous localities in the Philippine region, ranging in depth from 14-400 fathoms, but most common at shallow depths. Hofker records it from several stations in the Malay Archipelago, and Hada from the coast of Japan.

Our figured specimens are from the Pliocene, from base of 4-foot clay shale at top of 9-foot section, in road-cut 2.3 kilometers south of Kampong Tjimandang on the Malingping road, Bantam Residency, West Java, collected by L. W. LeRoy. It was found in a living state off the coast of West Java at depths ranging from 20-30 meters.

CRIBROLINOIDES ALBATROSSI (Cushman)

Quinqueloculina albatrossi CUSHMAN, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 435, pl. 85, figs. 4 a-e; text figs. 25-33.

This species has a very different ornamentation from the preceding in the early stages, and becomes smooth in the adult. It is recorded from the following general localities: China Sea, off southern Luzon; Sulu Sea, off western Mindanao, near Basilan Island; off Jolo, off Tawi Tawi; off Romblon; off northern Cebu; off western Samar; Gulf of Davao; China Sea, off Formosa; between Cebu and Bohol; between Samar and Leyte; between Negros and Siquijor; Tara Island; and to the south at two stations in Buton Strait.

The depths range from 18 to 500 fathoms, but the stations at which it was really common range from 23 to 57 fathoms, somewhat similar to that for the preceding species.

It will be interesting to see what other species are found in this same region, either Recent or fossil. The genus is probably a late development in the general Philippine-Malay area.

The form which d'Orbigny referred to his genus *Uniloculina*, *U. indica* d'Orbigny, was from the coast of India but this may refer to the "Indies." There is no more definite locality given for it. The figure given by d'Orbigny (Foram. Foss. Bass. Tert. Vienne, 1846, p. 261, pl. 21, figs. 53, 54) shows a form with distinct costae, not unlike our Pl. 3, fig. 2, but with costae more regular and more numerous. The apertural view is less rounded

than in our species. The whole appearance of d'Orbigny's figure suggests that it is much conventionalized. This may be the young stage of another species in this same general region but an examination of the type with adults would be necessary to determine this.

Also of interest in this connection is the generic name *Adelosina*, (Foram. Foss. Bass. Tert. Vienne, 1846, p. 301), applied by d'Orbigny to the three-chambered stage of several species of the Miocene of the Vienna Basin, the Pliocene of Italy, and living forms from the Adriatic. These are in the same stage as that shown in our Pl. 3, fig. 4, where after the coiled *Cornuspira* stage, the first of the milioline chambers, one-half coil in length is added. Such stages are not uncommon in the Vienna Basin material but may be associated easily with the adult species to which they belong. Both of these supposed genera now may be definitely placed in their proper position as young stages only.

RECENT LITERATURE ON THE FORAMINIFERA

Below are given some of the more recent works on the foraminifera that have come to hand.

Hanzawa, Shoshiro. Studies on the Foraminifera Fauna Found in the Bore Cores from the Deep Well in Kita-Daito-Zima (North Borodino Island).—Proc. Imp. Acad. Tokyo, vol. XIV, 1938, pp. 384-390.—Lists numerous species of foraminifera.

Keijzer, F. Mitteleozäne Foraminiferen aus dem Flysch der Umgegend von Omis, Dalmatien.—Proc. Kon. Ned. Akad. Wetenschappen, vol. XLI, No. 9, 1938, pp. 1-7, text figs. 1-20.—Some species noted as "n. sp." but not named.

Palmer, Dorothy K. *Planulina alavensis*, a New Cuban Oligocene Foraminifer.—Mem. Soc. Cubana Hist. Nat., vol. XII, No. 5, Dec., 1938, pp. 345-346, text figs. A-C.

Bermudez, P. J. *Aguayoina asterostomata*, un foraminifero nuevo del mar caribe.—L. c., pp. 385-388, pl. 29.—A new genus erected for a peculiar, sessile form.

Parejas, Ed. and A. Fuat Baykal. Une lame de charriage à Sile (Kocaeli-Anatolie).—Publ. Institut. Geol. Univ. Istanbul, New Ser., No. 1, March, 1938, pp. 1-6.—Mention foraminifera.

Parejas, Ed. Essai sur la géographie ancienne de la région de Geneve.—L. c., No. 2, May, 1938, pp. 1-50.—Mentions a few genera of foraminifera only.

Albritton, Claude C., Jr. Stratigraphy and Structure of the Malone Mountains, Texas.—Bull. Geol. Soc. America, vol. 49, 1938, pp. 1747-1806, 9 pls., 5 text figs.—Lists numerous foraminifera.

Howe, Henry V. and James H. McGuirt. Salt Domes of Iberville and Ascension Parishes.—Geol. Bull. No. 13, Dept. Conservation, Louisiana Geol. Survey, Aug., 1938, pp. 87-187, 21 text figs. (charts and maps).—Lists numerous foraminifera.

Howe, Henry V. and Stanley M. McDonald. Two New Species of the Foraminiferal Genus *Marginulina* from the Sorrento Oil Field, Louisiana.—L. c., pp. 209-211, pl. 1.—*Marginulina ascensionensis* and *M. sorrentoensis*, n. sp.

Liebus, Adalbert. *Orbitella apiculata* im Wienerwaldflysch.—Verh. Geol. Bundesanstalt, No. 6, 1938, pp. 143-147, 6 text figs.—Figures several sections.

Howchin, Walter and Walter J. Parr. Notes on the Geological Features and Foraminiferal Fauna of the Metropolitan Abattoirs Bore, Adelaide.—Trans. Roy. Soc. So. Australia, vol. 62, pt. 2, 1938, pp. 287-317, pls. XV-XIX.—Numerous species noted and figured, the following new: *Quinqueloculina adelaideensis*, *Spiroloculina lapidigera*, *Nubeculariella cultrata*, *Elphidium rotatum*, *E. adelaide*, *Discorbis cycloclypeus*, *Sigmomorphina subregularis*, *Operculina umbonifera*, *Rotalia vermiculata*.

Singleton, F. A. Correlation of Tertiary Rocks of Australia and New Zealand.—Rep't Australian and New Zealand Assoc. Adv. Sci., vol. xxiii, 1938, p. 442.—Mentions foraminifera.

Crespin, Irene. Tertiary Rocks in North-West Australia.—L. c., p. 4.—Mentions numerous foraminifera.

Chapman, Frederick. Notes on Tertiary Correlation.—L. c., p. 7.—Mentions numerous foraminifera.

Siegfus, Stanley S. Stratigraphic Features of Reef Ridge Shale in Southern California.—Bull. Amer. Assoc. Petr. Geol., vol. 23, No. 1, Jan., 1939, pp. 24-44, 5 text figs.—Notes occurrence of a number of foraminifera.

Canfield, Charles Reiter. Subsurface Stratigraphy of Santa Maria Valley Oil Field and Adjacent Parts of Santa Maria Valley, California.—L. c., pp. 45-81, 8 text figs.—Notes occurrence of numerous key species of foraminifera.

Meyer, Willis G. Stratigraphy and Historical Geology of Gulf Coastal Plain in Vicinity of Harvis County, Texas.—L. c., vol. 23, No. 2, Feb., 1939, pp. 145-211, text figs. 1-8 (charts and maps).—Mentions numerous foraminifera.

Rukas, Justin M. and D. David Gooch. Exposures of Vicksburg Oligocene Fauna in Western Louisiana.—L. c., pp. 246-250.—Lists many foraminifera.

Eaton, J. E. Danger in Reporting Fossils Far Beyond Their Indicated Range and Environment.—L. c., pp. 250-253.—Mentions foraminifera.

Cosjin, A. J. Statistical studies on the Phylogeny of some Foraminifera.—*Cycloclypeus* and *Lepidocyclina* from Spain, *Globorotalia* from the East-Indies.—Leidsche Geologische Mededeelingen, vol. X, pt. 1, 1938, pp. 1-61, text figs. 1-11.—Detailed studies of development in several forms.

Umbgrove, J. H. F. A Second Species of *Biplanispira* from the Eocene of Borneo.—L. c., pp. 82-89, 17 text figs.—A new species, *Biplanispira absurdia*.

FORAMINIFERA

Their Classification and Economic Use

Second Edition

AN ILLUSTRATED KEY TO THE GENERA OF THE FORAMINIFERA

by JOSEPH A. CUSHMAN

Lecturer in Micropalaeontology, Harvard University

The two volumes, cloth bound, with 426 pages and 71 plates
sent on receipt of price, \$5 express paid in U. S. A.;
\$6 postpaid, Foreign.

Special Publ. No. 7. A Monograph of the Foraminiferal
Family Verneuilinidae. 170 pages and 20 plates....\$3.50
Special Publ. No. 8. A Monograph of the Foraminiferal
Family Valvulinidae. 210 pages and 24 plates....\$4.00
Special Publ. No. 9. A Monograph of the Subfamily Virgu-
lininae. 240 pages and 24 plates.....\$4.00

Price list of available foraminiferal literature sent on request.

Topotypes of many species available: 50c per slide.

CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

SHARON, MASS., U. S. A.

CHECK LIST OF AMERICAN CRETACEOUS FORAMINIFERA

[by LOIS T. MARTIN

Geographic and geologic distribution of 875 species, with
accompanying bibliography, and indices to genera, species,
and synonymy.

Available after September 1, 1936, at \$4.50 a copy, by subscription.
Price after copies mailed to subscribers will be \$5.50. Make checks pay-
able to LOIS T. MARTIN, Stanford University, California.

